Final Project Report to the NYS IPM Program, Agricultural IPM 2002-2003

Title: Monitoring Greenhouse Nutrient Solutions for Poinsettias

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Cooperators: Tom Weiler, Horticulture Department, Cornell University
The managers and owners of 15 greenhouse operations
Julian Malone, intern from the University of Adelaide

Type of Grant: Cultural methods; sanitation; physical controls
Training practitioners to use IPM techniques

Project locations:

Bakers Acres, Inc, North Lansing
Barone Gardens, Cicero
Cornell University Floriculture Program, Ithaca
Ken Henry & Sons, Hamburg
Lisa's Greenhouse, Orchard Park
Lockwood's Greenhouse, Hamburg
Mischler's Florist, Williamsville
Mitchell Farms, Alden
Morroni's Greenhouse, Elmira
Plantscape Horticultural, Inc., Elmira Heights
Rudy's Greenhouse Inc, Elmira
Schaefer's Gardens, Triangle
Stella Ireland Gardens, Binghamton
WD Henry & Sons, Eden
Zerrillo's Greenhouses, East Syracuse

Abstract: Many greenhouse managers do not fully comprehend the relationship between crop fertility and ground water pollution, and impacts of fertility on pest & disease. Better management of fertilization improves crop quality and reduces nutrients lost to the ground(water). We tested pH and soluble salts weekly during the Poinsettia growing season, and sent off soil and foliar samples to Peters for lab analysis. In general, the growers highly valued the project because cultural errors were caught early. Several of them will continue the monitoring in the future; the others would like a professional to do it for them. We need to extend understanding of the importance of monitoring nutrient solutions to other greenhouse operations, and also to revise the Poinsettia crop production guide for New York.

Background and justification: The Survey of Current Greenhouse IPM Practices in 2000 revealed that very few growers monitor their water quality and nutrient solutions. These

practices are critical to plant health in an environment embracing IPM. In the past, IPM efforts focused on Poinsettia root rots and white fly management, and we stressed the importance of pest monitoring and correct diagnosis. New York producers seek unbiased advice from Cornell Cooperative Extension to make decisions that are based on research, including best cultural practices and ways to optimize their chemical inputs. The Poinsettia crop is an expensive one, since cuttings arrive in July or August and are sold with mature bracts in December. Most growers apply fungicide, insecticide and growth regulators, as well as constant nutrient solution. The crop is labor intensive, with pinching, potting, and spacing as the plants grow. It is clear that we need to generate Poinsettia guidelines that support crop quality as well as responsible environmental stewardship.

This IPM funded project is part of a larger program to teach New York growers about Best Management Practices and protecting their watersheds. Cornell Cooperative Extension associated faculty and staff worked with University experts in Occupational and Environmental Health and Facilities to develop six Agricultural Environmental Management (AEM) worksheets on greenhouse practices for commercial operations: Fertilizer Storage and Handling, Greenhouse Pest Management, Pesticide Storage, Weed Management, Greenhouse Remodeling and Construction, and Greenhouse Maintenance.

The goal of this project was to increase the efficiency of the use of fertilizer inputs in greenhouses, track changes in crop quality and pesticide use, and train growers and colleagues in the advantages of protocols for nutrient monitoring. The expectation was that monitoring would allow reductions in fertilizer use. There is a substantial grower contribution to the cost of this program, as they are expected to pay for the laboratory analysis of foliar samples at the beginning, middle, and end of the season.

Objectives:

a. Enroll about 20 Poinsettia growers who will support weekly monitoring for soil pH and soluble salt levels, and pay for 3 complete foliage tests
b. Growers will learn the routine use of electronic meters for soil pH and soluble salts
c. Extension Educators and IPM Scout will record weekly data; growers will report pest incidence and pesticide use, and changes in nutrition programs during the production cycle
d. Information regarding relationships between nutrients, pests and diseases will be shared in a timely fashion with individual operations
e. Document changes in fertility practices and any quality issues
f. Final evaluations will include collective sharing of information at an end of the season wrap-up

Procedures:

a. Fifteen growers allowed us to follow their Poinsettia crop production. Several were responsible for doing their own monitoring or for bi-weekly monitoring. Eight growers gave us their pesticide records when we visited them late in the season.
b. An abbreviated version of the North Carolina State PourThru Method was used in this project in order to speed up the procedure. Six plants (usually 6 inch pot Prestige) were selected at random by the grower and watered with normal nutrient solution about an hour prior to the monitoring. The person monitoring calibrated the pH and EC meters once each day. He or she placed a saucer under each pot and poured 100 ml distilled water (or more if necessary) onto the

soil of each pot. The leachate in the saucer was poured into a beaker and the pH and EC were determined and recorded. Saucers and beakers were rinsed and stored until the next testing.
c. Nine growers were interviewed regarding types of fertilizer used, ppm applied, pest issues that arose during Poinsettia production, abiotic disorders, and anything unusual that was observed.
d. During weekly monitoring, specialists were available for on site consultation. Each commercial greenhouse operation sent in foliar samples (one newly matured leaf from each of 20 plants) for Peters Laboratory analysis three times during Poinsettia crop production, and there was one soil test done at the Peters Laboratory for each operation.
e. The results and impact statements were compiled.
f. Meetings were scheduled for Dec. 31 at Kenneth Post Lab, Ithaca for the South Central Tier; and Jan. 15 at Erie County CCE, East Aurora, for the Buffalo area growers. The summaries of the data will also be shared with the Syracuse area growers in January.

Results and Discussion:

We enrolled 15 greenhouse operations in the Poinsettia nutrient monitoring project. A meeting was held in early summer to inform greenhouse growers in Erie County about the project, and how it would be useful to them. In the Syracuse area, two growers who have weekly IPM scouting by an independent professional wanted very much to add nutrient monitoring to the regular program. It was the second year of monitoring nutrient solutions for growers in South Central Tier. The Cornell Floriculture Poinsettia variety trial was managed by an undergraduate student who did the nutrient monitoring, wrote up the cultural protocol and hosted the Poinsettia Open House. Cultural practices varied among growers, such as frequency and volume of irrigation and type, concentration, and frequency of soluble fertilizer application. We took the opportunity offered by this project to assess pest management practices, and to observe correlations between problems detected (pH and EC outside the healthy range, excess nutrients or deficiences) and pest problems.

We saw crop losses this year due to root rots (300 plants lost at one operation, 400 at another, due to *Pythium, Rhizoctonia*, and/or *Theilaviopsis*) and many operations with high fungus gnat populations, the vectors of disease. *Botrytis* was a problem in some greenhouses where cool dark weather led to high humidity and condensation. In at least one greenhouse white fly was an issue late in the season. Some unusual symptoms occurred that were not in textbooks, that will warrant further detective work. Hopefully the large amount of information we gathered will be useful in the diagnoses.

The North Carolina State University PourThru method has been taught at many bedding plant schools and at the Ohio Florists Short Course. The NC State web site and their book, Plant Root Zone Management (Whipker et al., 2000) provide good basic instructions on water quality and nutrient solutions. For Poinsettia, they recommend a pH range of 5.6 to 6.0. Poinsettia is included in the group of heavy feeders with Chrysanthemum and vegetative petunia, that should have a PourThru EC of 2.6 to 4.6 mS/cm. However, a less concentrated nutrient solution is recommended for the establishment and finishing stages, with EC between 1.9 and 2.7 mS/cm. During the mid season, the soluble salts should increase to EC between 2.8 and 4.1 mS/cm.

We shortened the PourThru sampling protocol by using six potted plants instead of ten; this may decrease the accuracy of the measurement, but makes it a more grower-friendly procedure.

Sometimes due to local variability in watering or timing, the amount of distilled water required obtain 50 ml of leachate was greater than 200 ml. Displacement of the soil water solution is the principle at work. If a large volume of water must be added to drain 50 ml, the soil water might be diluted with the distilled water, leading to low EC readings. The pH values may appear more like the distilled water than the local water. Some growers watered with clear water occasionally, others always used nutrient solution. This is another source of variability in the data.

The importance of monitoring is to detect problems early. Some growers were surprised to see that their pH was above 6.6, and they changed their fertilizer or acid injection practices. Growers discovered that the EC was too high, perhaps because the plants were not taking up nutrients as rapidly as they were delivered, or the pots weren't being leached sufficiently. The current readings were very valuable to the growers. In addition, Cornell diagnosticians were surprised to see that the concentration of applied nutrients was so great; root rot pathogens such as *Pythium* thrive on roots that are exposed to high salts. This is an opportunity to discuss such issues with growers and perhaps recommend less fertilizer for the darker climate in New York, compared to North Carolina.

The complete data table of pH and EC values from this project will be given to the participating growers to show how the season turned out for the group. Over the entire season and 15 greenhouse operations, the average pH ranged from 5.5 to 6.8. The lowest average weekly pH was 4.9 and the highest was 7.1. Maintaining pH between 5.4 and 6.2 is a serious challenge for many operations. Upstate well water can contain minerals that bring high alkalinity. The remedy may be the use of acidifying fertilizer that contains ammonium rather than nitrate for some or all of the nitrogen, or sulfuric or phosphoric acid may be injected. Lab testing for water quality is recommended, and growers know that water quality changes over the season.

The total soluble salts in the leachate represent a combination of nutrients in solution and contaminants in the water. Appendix Chart A12.1 in Plant Root Zone Management gives the predicted EC of many different commercial fertilizers at dilution levels 50 to 1000 ppm nitrogen. This chart can be used to verify the calibration of injectors. A small subset of the chart is printed here to facilitate understanding the results of the project.

Electrical Conductivity (EC in MS/cm) values at dilution levels
often used with Poinsettia crop fertilizers

Fertilizer	100 ppm	200 ppm	300 ppm
Peters 21-7-7 Acid	0.56	1.12	1.68
Peters 15-0-5	0.75	1.50	2.25
Peters 21-5-20	0.58	1.16	1.74

The season average EC values for the Poinsettia crop in 15 greenhouse operations ranged from 1.54 to 5.76. The highest values may represent grower error, unintentionally high fertilizer applications that were corrected. At each operation, the EC of the water should have been known, although we didn't subtract it here, because the values in the plant leachate represented

the situation for plant roots. See Figures 1 and 2 for the pH and EC data from two operations, one with optimal values (Fig. 1) and one with high pH and erratic EC (Fig. 2).

The foliar analyses revealed nutrients present at levels too low or too high (possible deficiency or toxicity) for each sample set of leaves analyzed, submitted by all operations. Possible toxic levels of nutrients included potassium and phosphorous (71% of operations), nitrogen (50%), and molybdenum (36%, one crop with a very high level). The most common deficiences were boron and copper (93% of the operations), calcium (71%), iron and molybdenum (57%). The symptoms of iron chlorosis were visible in at least one crop. Less obvious symptoms may have been exacerbated pest management problems with thrips, mites, whitefly and fungus gnats (Figure 3). The calcium deficiency and high soluble salts may have impaired the resistance of some crops to root rots, favoring *Pythium* development (calcium is a factor in forming strong cell walls for plant defense, high salts lead to wound sites for pathogen entry). We will look at the operations with the best foliar samples for model fertilization practices. It appears that 50% of the crops received too much fertilizer for at least part of the season.

The number of pesticide and growth regulator applications varied tremendously between the operations (Figure 3). Some growers were very happy with their quality, others would like to do better next season. Growth regulators were applied to some Poinsettia crops; others received none. Most operations complained that their crop was shorter than average. In one operation where a small group of plants was too tall, the suggestion was made to use them for a cut flower exhibit in the retail shop. Cut Poinsettias have an excellent vase life, and may sell for $4 to $5 per stem.

It is our hope that this study will increase the efficiency of fertilizer and chemical use. The expense of these applications includes cost of product and labor, potential impact on the environment, and exposure of workers. Some growers have already adopted the principles of Best Management Practices to preserve water quality and IPM strategies, and what is needed is minor fine-tuning. Others can benefit from the examples of their colleagues, and reduce their fertilizer load and pesticide use substantially. Each of the growers hopes to continue the nutrient monitoring in the future; the adoption level was 100%. We will be discussing the many valuable lessons learned by this project with each of the participants.

The impacts of the project included several satisfied participants who were able to correct problems that were detected by pH and EC monitoring. In some cases, the pH needed to be raised, in others lowered. Growers changed their fertilization regime in response to the foliar analyses, adding trace elements or calcium. Here are some quotes from growers in the project:

"This project opened my eyes to the need for monitoring pH and EC. It also increased my awareness as it relates to our soil mixing procedures. I will now evaluate the soil mix more thoroughly and check to see that the appropriate amounts of fertilizer and lime are being used." Steve Lockwood, Lockwoods Greenhouse

"I felt that this program verified my current practices. I was not sure about the fertilizer rates that I was using for this crop that is sub-irrigated. After monitoring pH and EC throughout the

season I feel that we are using the correct rate to produce a nice crop." Wendell Ireland, WD Henry and Sons

"As a result of this project I decided to test other plant material that was not included in the project. I expected to find very high salts and found almost no fertilizer in the baskets that I tested. We traced it back and found a valve that had not been turned on." Mark Yadon, Mischler's Florist

The next step in the process of increasing adoption of nutrient monitoring by New York greenhouse growers is to develop Poinsettia crop guidelines. Jillanne Burns of Suffolk County CCE will be spearheading this effort in the near future funded by the Long Island Friends of Horticulture; we will offer her the information gleaned from experience with 15 growers.

Follow-up questions suggested by Karen Hall:
1. EC often seemed to be lower than recommended by North Carolina, yet the crop looked good. Is this a regional issue or site specific? How do fertilizer type and soil mix affect optimal range of soluble salts?
2. What are the dates, or range of dates, associated with the establishment, growing, and finishing stages? How does this relate to days after planting or when the lights are turned off?
3. Would you expect to see a different EC on the side of the pot with the drip emitter? Would the dry side have a higher or lower EC?
4. What differences should we see between different types of irrigation systems? Are the EC's higher in a sub-irrigated system?

Figure 1. Grower # 8 pH and EC

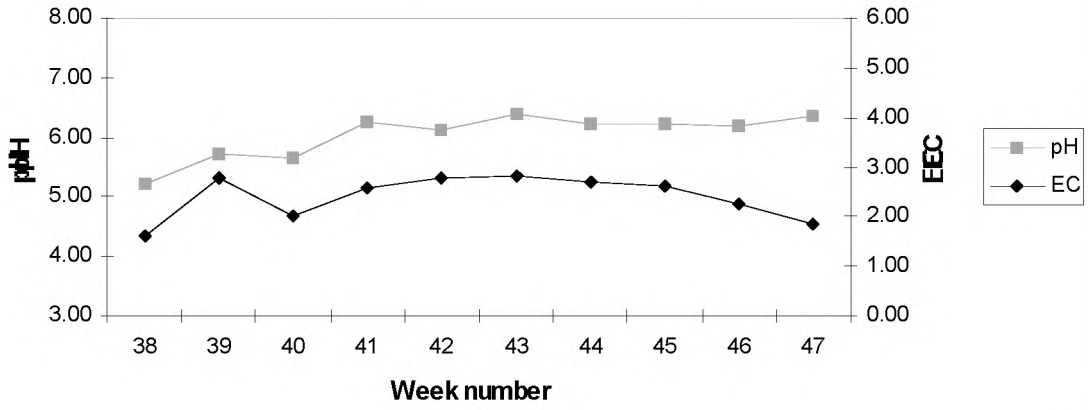

Figure 2. Grower # 5 pH and EC

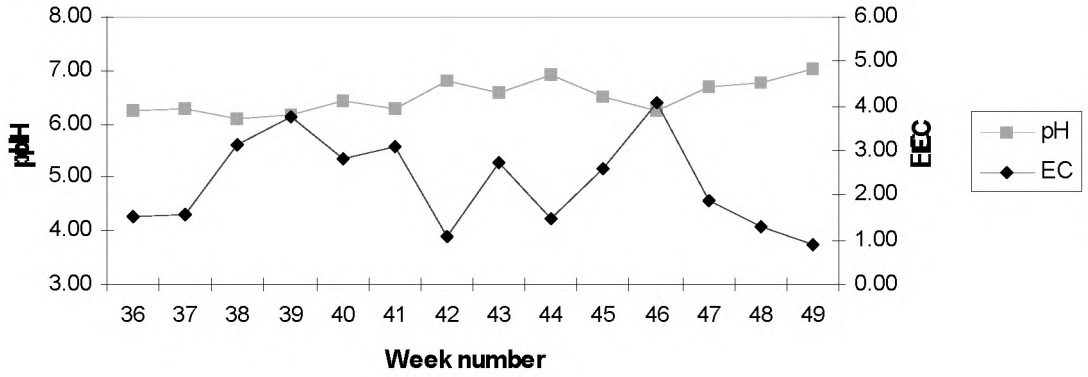

Figure 3. Chemical Applications on Poinsettias